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The evaluation of road infrastructure development projects

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Abstract

The evaluation of road infrastructure development projects is an important stage in the development process, as it makes it possible to check upon completion whether the designed infrastructure meets the objectives originally set for it. Since this stage is too often poorly known and forgotten, the Belgian Road Research Centre has developed an evaluation methodology for use by the Brussels Mobility department of the Brussels Capital Region. This methodology was applied to a number of major road infrastructure projects and yielded detailed information on the quality of the developed infrastructure and on any improvements to be made to it in order to meet its pre-set objectives as closely as possible.

Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)

Keywords: evaluation; road infrastructure; indicators

1. Introduction

Whereas the long and complex process involved in any development project, from preliminary design to the final acceptance of works, is well-established in the habits and practice of road design and construction, the ex-post evaluation process is poorly known and generally forgotten. Now it is of primary importance to evaluate upon completion whether the developed infrastructure does meet the objectives it was originally designed for. It is also

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important, through this evaluation, to draw both positive and negative lessons from completed projects, so as to better guide the choice of measures to be recommended in future and to meet the objections that may be raised in the field by various actors such as roadside residents, traders, and representatives of various associations and organizations. With respect to these objections, clear communication to provide an objective basis for discussion would, under certain circumstances, help to avoid excessive delays in the development process.

Given the fact that few road infrastructure projects implemented in the Brussels Capital Region are actually evaluated, the Belgian Road Research Centre (BRRC) has developed, at the request of the Strategy Directorate of the Brussels Mobility department, a general evaluation process methodology that can be applied to any road infrastructure project. This process was used between 2011 and 2013 to evaluate three major road infrastructure redevelopment projects in Brussels before works: the Avenue du Port, the Avenue Woeste and the Chaussée de Waterloo (section Legrand-Churchill).

Since it was presented at the Transport Research Arena conference in Paris 2014, the process has gone through some major developments. Whereas in 2014 only ex-ante evaluations were available, a full evaluation of an infrastructure redevelopment project was completed in 2015. The main conclusions from this evaluation are presented in this paper. On the other hand, the application of the process in the field proved rather complex because of the wide variety of data items to be collected. To remedy this, BRRC has been developing since September 2015 a georeferenced computer-based system for collecting data on problems found on site. This system will be presented in detail in the second part of this paper.

2. Prerequisites for the development of the process methodology

The evaluation process was developed while meeting a number of prerequisites set from the beginning by the Brussels Capital Region:

- the evaluation process should not be too constraining: it is important that it can be completed within a reasonable lapse of time. In view of the many stages involved in infrastructure projects, it is, indeed, important that this new stage, which is to become general practice in future, should not constitute an additional constraint that would make the procedures even more tedious. This lapse of time, and the consequent cost, will of course depend on the magnitude of the project, but also on the availability and, therefore, sometimes the collection of the data required for the evaluation, as well as on the various objectives to be met by the infrastructure;
- the evaluation tool to be developed does not aim to evaluate the choices made by the manager as to the choice of type of road infrastructure to be provided (e.g., development of a one-way of a two-way cycle track), but rather to investigate the infrastructure as determined by the manager so as to verify its compliance with the various development principles governing any road infrastructure project;
- the tool should be capable of evaluating infrastructure projects, not mobility projects. Although the aspects directly related to mobility (traffic flows, commercial speed, accidents, etc.) must not be overlooked, the items to be evaluated are mainly infrastructural. In concrete terms, for example as far as public transit is concerned the evaluation should bear on the quality of bus stop facilities (size, equipment, pavement condition) rather than on passenger statistics or commercial speeds on the various bus lines;
- the tool should be seen as a help to the manager and the project designer, which does not relieve them of their tasks in any way. Common sense should prevail.

This evaluation tool could also be used in other regions and/or municipalities in Belgium and even abroad – with certain adaptations, since the objectives of development projects will not necessarily be same as in the Brussels Capital Region.

3. Evaluation methodology for road infrastructure projects

The basic principle for the evaluation process is represented in the diagram of Figure 1. It applies to any development project carried out in the Brussels Capital Region and is centred on the fact that any project is systematically evaluated for compliance with several pre-set objectives (W. Debauche et al., 2006).

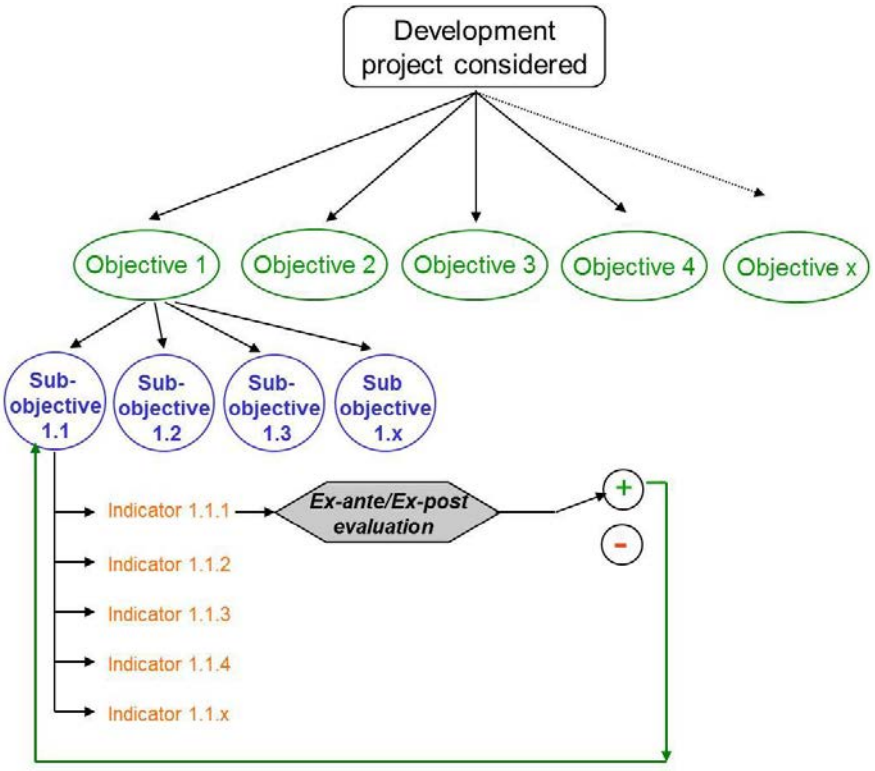

Fig. 1. Basic principle for the evaluation of a road infrastructure project.

In concrete terms, a series of sub-objectives is proposed starting from a list of pre-set objectives for the project considered. Several indicators are then defined for each of these sub-objectives. These indicators must be objectifiable and, therefore, quantifiable, to make the evaluation as objective as possible. The next important step in the evaluation process is to evaluate each indicator before and after the implementation of the project. Finally, the evaluation obtained per indicator before and after development is used as a basis to assess whether the sub-objective and, finally, the objective can be considered as achieved or not.

The objectives considered in any evaluation made in the Brussels Capital Region have been arranged by travel mode and are based on the objectives presented in the regional transportation plan IRIS II. The six “standard” objectives are:

- encourage walking;
- encourage cycling;
- increase the attractiveness and ease the flow of public transport;
- reduce the adverse effects of car traffic;
- allow for parking in infrastructure projects;
- allow for heavy goods vehicle traffic and goods delivery.

To allow a more detailed analysis of these six objectives, decomposition is made into sub-objectives. These are set directly under the relevant objective. For example the two sub-objectives characterizing the objective “encourage walking” are:

- improve pedestrian traffic on links;
- improve pedestrian crossings.

Fifteen sub-objectives in total are considered in this tool. They are evaluated by some sixty indicators, which are analysed in two different ways:

- computerized analysis using mapping and other data available on the study area;
- analysis on site to collect unavailable computer input data and also to update certain data that is not recent.

No KPI (Key Performance Indicator) shall be calculated by BRRC during the evaluation. Since the weight of each indicator varies from one project to the next, it is up to the Brussels Capital Region, if it wishes to do so, to perform the weightings and calculations while considering the priorities assigned per indicator in each project.

Most of these indicators can be quantitatively evaluated against exact numerical standards and criteria in force the Brussels Capital Region (e.g., mean illuminance level (Eh mean) of 20 lux required on footways (O. Van Damme et al., 2012)). Various devices and tools are used to collect the relevant data:

- luxmeter;
- measuring bike;
- sound level meter;
- laser speed gun;
- vehicle turning manoeuvre software;
- …

Qualitative evaluation is avoided as much as possible, to keep the evaluation process objective.

At the end of the evaluation, a comparison of the results obtained for the six objectives before and after works results in a full final evaluation of the entire development project considered.

4. Implementation of the methodology

To apply the process methodology to a practical case, BRRC made an evaluation of the Chaussée de Waterloo (section Churchill-Bascule) in 2013, before works (ex-ante evaluation). This evaluation was repeated early in 2015, upon the completion of the works (ex-post evaluation).

The various steps performed in evaluating the Chaussée de Waterloo are represented in the diagram of Figure 2.

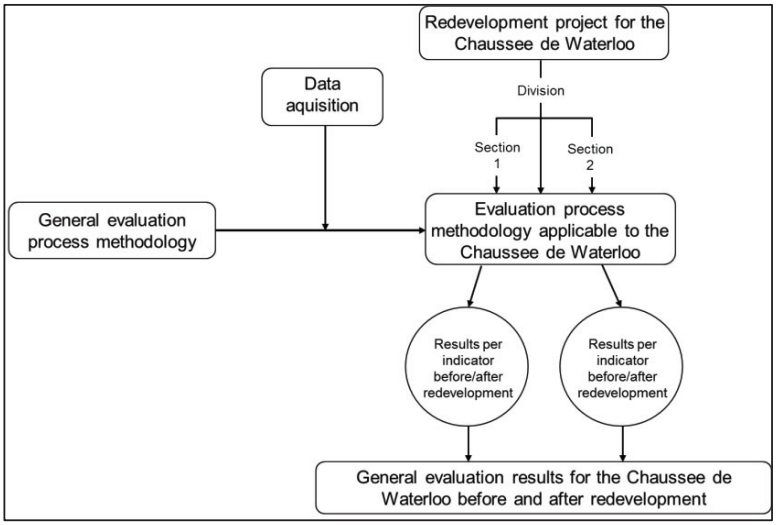

Fig. 2. Diagram of the various steps performed in evaluating the situation before and after the redevelopment of the Chaussée de Waterloo.

In concrete terms, using the general process methodology various data specific to the Chaussée de Waterloo was collected:

- mapping data;
- traffic loading;
- pedestrian and cyclist counts;
- speed of motorized traffic;
- traffic signal diagrams;
- commercial speed and ridership of public transport;
- accident data;
- noise levels;
- illuminance levels;
- …

Using this data in the general process methodology made it possible to implement a specific evaluation process for the Chaussée de Waterloo.

Because of its size (0.8 km long), the study area was divided into two sections in order to refine the analyses and the data obtained. The application of the process methodology to the two sections resulted in an evaluation per section and, after the results had been aggregated, in a full evaluation for the entire Chaussée.

5. Results

The evaluation first focused on the six "standard" objectives of any project for the development of road infrastructure in the Brussels Capital Region. To evaluate them, fifteen sub-objectives quantified by sixty-three infrastructural indicators were analysed before and after works. The results show that none of the six "standard" objectives can be considered as fully achieved. Five have been virtually achieved but not completely, for different reasons:

- the objective to encourage cycling has been virtually attained (comfortable pavement, better lighting, more bicycle parking facilities) except on one stretch of the road where the cyclist is hemmed in between tram rails, whereas before works he had enough space to ride next to the rails along the parking area;
- the objective to increase the attractiveness and ease the flow of traffic by redevelopment has been virtually achieved, since the project has made it possible to offer more high-quality walking space to pedestrians as well as better traffic infrastructure. Only podotactile elements and lighting at stops are still missing. The loss of commercial speed in evening traffic on the tram line using the Chaussée needs to be re-discussed with the Brussels Mobility department, to find ways for improvement;
- the objective to reduce the adverse effects of car traffic can be considered as reached except for night-time road safety, since inadequate illuminance levels can still be found on different spots;
- the objective to allow for parking in the redevelopment project for the Chaussée de Waterloo (section between Legrand and Churchill) can be considered as attained, with the exception of parking bays for handicapped people. Whereas three bays should be available after works, only two are actually provided, one of which does not meet the prevailing standards;
- the objective to allow for heavy goods vehicle traffic has been met, unlike that to allow for goods delivery: none of the four delivery areas provided meets the regulations for marking, signing and geometric design.

The objective to encourage walking has not been met by the redevelopment project. Pedestrians remain confined to spaces that are too narrow and the opportunity of a full redevelopment of the infrastructure has not been seized to remedy the problem. The pedestrian crossings, which were a big problem before works, have been improved except at the Churchill junction, which remains a black spot for pedestrian accessibility. Another "black spot" is lighting, which is critically missing at eleven of the fourteen redeveloped pedestrian crossings.

The evaluation also focused on seven objectives set specifically in the redevelopment project for the Chaussée de Waterloo. Thanks to the methodology implemented, the analysis for these seven objectives did not require any new evaluations in particular, since the specific objectives were covered directly or indirectly by the "standard"

objectives evaluated before. From the results of the evaluation for the seven project-specific objectives it appears that two of them, viz. to renovate the footways and to reduce noise annoyance, have been fully achieved. One objective, i.e. to improve comfort at public transport stops, has been virtually attained. Four other objectives – to improve road safety, lighting, tramway traffic and pedestrian crossings – have not been met.

6. Evaluation budget

The budget spent on the evaluations before and after works was calculated. This approach can be explained by the fact that time and cost to be devoted are often invoked as a reason for not evaluating an infrastructure project. The evaluation took twelve working days before works and sixteen days after works, amounting to a total of twenty-eight days. This represented roughly 0.006 % of the total budget spent on the redevelopment of the Chaussée de Waterloo. However, this calculation does not include the work done by several people not employed by BRRC, who were contacted to provide necessary data for the evaluation. The total estimate should, therefore, be revised upwards, but nevertheless remains practically insignificant with respect to the total budget of the redevelopment project.

7. Development of a computer-based tool for data collection on site

Because of the many indicators to be evaluated per road section analysed, work to collect data on site and also to process these data rapidly becomes substantial. During the first evaluations performed by BRRC this work was done simply using a plan on paper and a measuring rule, with subsequent re-transcription back in the office. As a result, the need to develop a computer-based tool for data collection on site was rapidly felt. Since 2015 BRRC has been working on this tool, which is illustrated in Figure 3. In concrete terms, the person in charge of recording data has software which is installed on a tablet computer and enables him to encode the data required for calculating the indicators directly on site. This data is georeferenced and is collected while following for each indicator a pull-down menu which specifies all the items to be recorded. This makes sure that no data is forgotten during the collection on site. Back in the office, the items recorded for each indicator can also be rapidly plotted and viewed on maps. The processing of collected information is thereby improved – both in quality and in time to be spent on the analysis.

This tool is currently in the testing phase, with a view to systematic use during new evaluations in future.

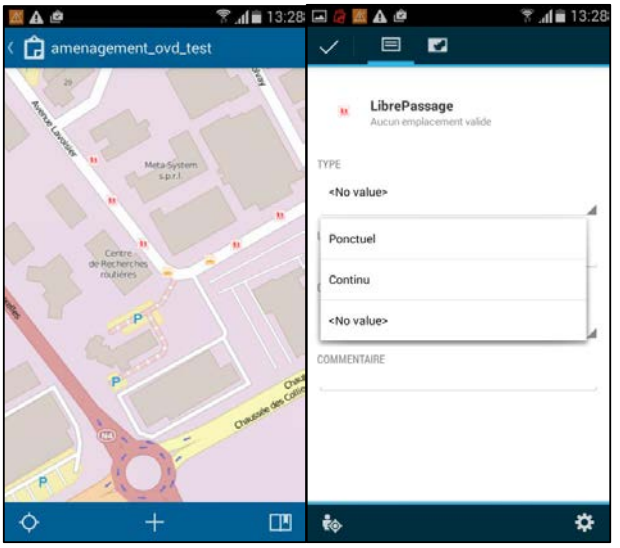

Fig. 3. Encoding interface developed for data collection on site.

8. Conclusion

The methodology developed since 2011 by BRRC with the help of Brussels Mobility department was tested in various situations before redevelopment works, but went through a new stage in 2015: by making an evaluation after works, a full evaluation of a redevelopment project was obtained. A comparative analysis of the data collected – and the indicators calculated from it – before and after works makes it possible to assess the extent to which the major objectives of any redevelopment project have been met.

The conclusions from the evaluation of the Chaussée de Waterloo as presented in this paper show that several objectives have not been achieved. Although the broad lines of such a redevelopment project cannot be altered, a number of feasible recommendations were made in the evaluation report, to enable the client to improve the evaluation score of his project – sometimes with minor modifications – and ultimately the quality of the redeveloped facility.

The evaluation method as presented is a prototype which is refined and perfected as new evaluations are made. The development of a computer-based tool for data collection on site is one example of an improvement of the tool with a view to more systematic use in any new development project for road infrastructure in the Brussels Capital Region.

With a few adaptations, mainly of the objectives for development projects to be evaluated, this evaluation method can also be used in other regions/municipalities and even abroad. This type of useful, practical and rapid tool most certainly has a future in the sector. BRRC is ready to continue developing and implementing the tool with the help of clients, through evaluations of road infrastructures scheduled for redevelopment.

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